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**METHOD AND APPARATUS FOR SAVING INSTALL PROPERTIES IN A  
FILESET OBJECT AND/OR SYSTEM REGISTRY FOR USE DURING  
UNINSTALL**

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**RELATED APPLICATIONS**

- Application serial no. 09/280,345 (Attorney docket no. AT9-98-869), entitled "A Cross-Platform Program, System, and Method Having a Global Registry Object for Mapping Registry Equivalent Functions in an AIX Operating System Environment"; Application serial no. 09/280,350 (Attorney docket no. AT9-98-852), entitled "A Cross-Platform Program, System, and Method Having a Global Registry Object for Mapping Registry Equivalent Functions in an OS/2 Operating System Environment";
- 10 Application serial no. 09/280,349 (Attorney docket no. AT9-98-851), entitled "A Cross-Platform Program, System, and Method Having a Global Registry Object for Mapping Registry Functions in a Windows Operating System Environment"; Application serial no. 09/280,371 (Attorney docket no. AT9-98-853), entitled "Global Registry Object for Mapping Registry Functions and Registry Equivalent Functions Across Multiple Operating Systems in a Cross-Platform Program"; Application serial no. 09/280,368 (Attorney docket no. AT9-98-861), entitled "A
- 20 Cross-Platform Program, System, and Method Having a System Independent Registry for Use on Operating Systems Irrespective of a Registry Equivalent"; Application serial no. 09/280,344 (Attorney docket no. AT9-98-862), entitled "A System, Method, and Program for Enabling a
- 25 Use of Property Object Having a Variable for a Property Value in a Cross-Platform Program"; Application serial no. 09/280,346 (Attorney docket no. AT9-98-865), entitled
- 30

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"A System, Method, and program for Overriding Program Properties"; Application serial no. 09/280,375 (Attorney docket no. AT9-98-858), entitled "A System, Method, and Program for Automatic Error Detection While Utilizing a Software State Machine for Carrying Out the Process Flow of a Software Program"; Application serial no. 09/280,376 (Attorney docket no. AT9-98-855), entitled "A System, Method, and Program for Utilizing a Software State Machine for Carrying Out the Process Flow of a Software Program"; Application serial no. 09/280,369 (Attorney docket no. AT9-98-859), entitled "A System, Method, and Program for Enabling a Software Program to Automatically Select a System-Dependent Function"; Application serial no. 09/280,372 (Attorney docket no. AT9-98-857), entitled "A System, Method, and Program for Mapping a Global Object to Desktop Elements of Different Operating Systems"; Application serial no. 09/280,370 (Attorney docket no. AT9-98-856), entitled "A System, Method, and Program for Processing Dependencies Using a Dependency Object"; Application serial no. 09/280,348 (Attorney docket no. AT9-98-854), entitled "A System, Method, and program for Modifying a Text File"; Application serial no. 09/280,351 (Attorney docket no. AT9-98-866), entitled "A System, Method, and Program for Updating Registry Objects with a Cross-Platform Installation Program"; Application serial no. 09/280,374 (Attorney docket no. AT9-98-867), entitled "A System, Method, and Program for Preserving Background Settings During Install and Uninstall Operations"; Application serial no. 09/280,347 (Attorney docket no. AT9-98-860), entitled "A System, Method, and Program for Modifying a Library Object"; Application serial no. 09/280,353 (Attorney docket no.

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AT9-98-864), entitled "A System, Method, and Program for  
Installation on Drives Using a Drive Object"; and  
Application serial no. 09/280,373 (Attorney docket no.  
AT9-98-868), entitled "A System, Method, and Program for  
5 Performing Program Specific Operations During the  
Uninstallation of a Computer Program from a Computer  
System".

The above are all filed on March 29, 1999, and are  
assigned to the assignee of the Present application, and  
10 incorporated by reference herein.

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## BACKGROUND OF THE INVENTION

### 1. Technical Field:

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This invention relates to install programs, and more  
specifically to an install program having a containment  
structure wherein each fileset contains at least one  
install object having all install properties saved  
30 therein such that they may be used when performing an  
uninstall operation.

## 2. Description of Related Art:

An installer program is a software program that enables a programmer to write specific code that will allow a user to install a given application program onto the drives of a computer in a way that enables the given application program to work correctly with the computer's environment including its operating system. There are several types of installers'- Java installers and operating system specific installers, e.g., Windows installers, OS/2 installers and AIX installers, etc.. Many of these install programs existing today have various limitations in their functionality as discussed below.

One type of Java installer is provided by a software company known as InstallShield. Currently, this Java installer has some limitations on certain functional features. For example, the Java installer provides default panels, but the text can't be changed or configured. Also, this Java installer is not easy to customize. In other words, a programmer cannot easily add a function to the installer program that it doesn't already do. In addition, the Java installer does not provide very much registry support. A registry is a central repository for all possible information for the computer such as hardware configurations and software settings, etc. The registry enables a user/ programmer to keep information about the software product. It enables a user to find out information about other products, based upon what the user/programmer put into the registry or what the user is looking for. Presently, the Java installer only works with a Windows' registry; and the support provided here is limited. For example, it does not enable the system Windows' registry

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to be updated directly. Instead, the keys to be updated are in a file which must be imported into the registry through a system call. It would be desirable if such a Java installer program supported multiple directories, splash screens (which are images that come up while a software product is being installed), and multiple languages instead of just English. Furthermore, it would be desirable for a given installer program to be more broadly applicable to other environments and operating systems. Although InstallShields' Java installer is tailored to Java, it is also geared somewhat for the Windows' operating system as discussed above in terms of the Windows' registry support provided. However, it does not provide specific support for other operating systems such as OS/2 or AIX.

Another Java installer is called "Install Anywhere" from ZeroG. This Java installer program also has a default panel that cannot be changed, i.e., it is not customizable in terms of the order in which the panels are to appear. Likewise, registry support is limited. A user/programmer updates a registry from a file using a "reg\_edit" command. Although this installer program enables a user/programmer to add a few items into the registry, the registry cannot be queried. In addition, other registry functional features are not available. Likewise, there is no multiple directory support, and no national language support. Also, it does not support multiple operating systems, i.e., there is no OS/2 or AIX specific support.

Another approach would be to provide install APIs for Java. However, this approach is not yet available.

With respect to operating system specific installers, InstallShield provides a Windows' installer. Although this installer program is widely

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used throughout the industry, it is based upon a proprietary scripting language that InstallShield defined. The scripting language is similar to Basic programming language. Nevertheless, a user/programmer  
5 must learn the scripting language to be able to write an install program, and it is not a real easy language to write in. When creating install programs using the Windows' 32 installer, a programmer must first learn the new language. Even then, it is difficult to write  
10 complicated install scripts with this scripting language.

For the OS/2 operating system, there is not a true architected way within the operating system itself to install. Two programs have existed for writing install code on OS/2. One of them is "Feature Installer", which  
15 has a tendency to be difficult to use. Also, it is hard to figure out how to write an install program from it. For example, it is tied into the workplace shell which requires special knowledge of SOM programming. Also, there is no compression of files. The second program is  
20 "Software Installer", which was the precursor to "Feature Installer", and is no longer supported as a product.

Also, for the OS/2 operating system, since OS/2 has Java on it, a programmer could use InstallShields' Java edition to write install code to install some types of  
25 programs. However, this does not provide much function other than just copying files.

Other than using Feature Installer, Software Installer, or a Java Installer, programmers must come up with their own way to write install code for an  
30 application program on an OS/2 machine.

Since the OS/2 operating system appears to have been architected without regard to install features, the above discussed ways for installing OS/2 application programs have no way to talk to each other. They will

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each have a different way of keeping track of things. As such, there is no one place to go to find out what has been installed on an OS/2 machine or to check dependencies to see what has been installed already.

5       For the AIX operating system, the command "installp" is used to install products. It is platform specific. It is also command line driven which is typical for the AIX operating system. Nevertheless, it appears to work well and is widely used.

10       As shown above, installers are tailored for a specific operating environment, e.g., JAVA, and/or operating system. As such, programmers using an installer to write install code must know and understand the specific operating environment and/or system quite  
15 well. This creates an added burden for a software company that produces many different application programs, with each application program available on many different operating systems. Separate install code must be written for each application for each different  
20 operating system. This requires a matrix of expertise - expertise in a given application, and expertise in a given operating system environment. This requires either a widely knowledgeable expert who is burdened with writing various specific versions of install code, or  
25 many different expert programmers who are essentially assigned the same task of writing install code.

Without such expertise, small software products just do not get install programs written for them for various platforms. In addition, money, resources, and time could  
30 be saved by writing an installer program only once that is applicable across all operating systems and environments.

In addition to the above, installer programs typically do not store variables or variable values

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during the installation of the program for later use during uninstall. Rather, the installation programs only store filenames and paths of the items actually installed so that these files may removed during the uninstall process. Because these variables and values are not stored, developers of uninstall programs are limited in the customization they may provide for the uninstall operations. Furthermore, other applications, during their respective installation on a computing system, may not obtain information about the programs already installed on the computing system and their installation variables. Thus, it would be beneficial to have an apparatus and method for storing installation variables and variable values such that other installations of applications and uninstall applications may obtain access to the variables and variable values for use in customizing the installation and removal of programs on a computing system.



**SUMMARY OF THE INVENTION**

The present invention provides an installation tool kit apparatus and method that allows developers to create  
5 installation programs in which all of the variables and variable values used during a product installation are automatically stored in one or more of a system product registry or database and a fileset object.

With one particular embodiment of the present  
10 invention, during installation of a product, the variables and variable values are stored in a hashtable. The hashtable is saved as part of a serialization of a fileset object. Thus, when the fileset is reinstantiated at uninstall time, all of the installation information is  
15 contained within the reinstantiated fileset. The fileset object and other objects used by the uninstall program can make use of this information to affect the uninstall behavior.

In another embodiment of the present invention, the  
20 variable and variable values are stored in a hashtable that is saved to the system product registry at the end of the installation process. Since this information is stored in the system product registry, other programs and tools may have access to the information. This allows  
25 other installation programs to query the registry for the required information and use this information in the installation of other products.

Since some variables and variable values may contain sensitive information, such as passwords for example, the  
30 present invention provides a mechanism by which sensitive variables and variable values may be filtered out during the automatic storing of installation variables. In this way, sensitive information is not stored in locations

where this information may be accessed by unauthorized programs and tools.

These and other features and advantages of the present invention will be described in, or will become  
5 apparent to those of ordinary skill in the art in view of, the following detailed description of the preferred embodiments.

**BRIEF DESCRIPTION OF THE DRAWINGS**

The novel features believed characteristic of the invention are set forth in the appended claims. The invention itself, however, as well as a preferred mode of use, further objectives and advantages thereof, will best be understood by reference to the following detailed description of an illustrative embodiment when read in conjunction with the accompanying drawings, wherein:

**Figure 1** depicts a block diagram of a data processing system in which a preferred embodiment of the present invention may be implemented;

**Figure 2** depicts the flow and structural components of a cross-platform installer program;

**Figure 3** illustrates various states for building a program containing filesets and objects, checking dependencies, and checking disk space as a prerequisite to installing or uninstalling filesets and object;

**Figure 4** illustrates an uninstall process;

**Figure 5** is a diagram illustrating the storing of variables and variable values during an install process;

**Figure 6** is a diagram illustrating the reinstantiation of a fileset during an uninstall process;

**Figure 7** is a flowchart outlining an exemplary operation of the present invention when storing variables and variable values to a fileset; and

**Figure 8** is a flowchart outlining an exemplary operation of the present invention when storing variables and variable values to a system product registry.

**DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT**

The following description and the accompanying drawings illustrate a preferred embodiment of the present invention. It is understood that other embodiments may be utilized, and structural and operational changes may be made, without departing from the scope and spirit of the present invention.

With reference to **Figure 1**, a block diagram of a data processing system **10**, i.e., computer system, in which a preferred embodiment of the present invention may be implemented is depicted. The computer includes a processor **11** and memory **12**. The computer **10** may be, but is not limited to, a personal computer, workstation, or a mainframe. The computer system also includes input means **13** such as a keyboard and/or mouse and/or track ball and/or light pen and/or pen-stylus and/or voice-sensitive device and/or touch-sensitive device, and/or other pointing devices and/or other input means. Also included are display means **14** such as a display monitor and other output means **15** such as printers, etc.

Memory **12** includes volatile or nonvolatile storage and/or any combination thereof. Volatile memory may be any suitable volatile memory device known in the art, e.g., RAM, DRAM, SRAM, etc.. Nonvolatile memory may include storage space, e.g., via the use of hard disk drives, for programs, whether or not the programs are being executed. The programs in memory **12** include an operating system program and application programs, such as an install program or an installer tool kit. If the memory **12** is comprised of volatile and nonvolatile memory devices, then data and programs may be swapped between the volatile and nonvolatile devices in a manner known in the art.

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The exemplary embodiment shown in **Figure 1** is provided solely for the purposes of explaining the invention and those skilled in the art will recognize that numerous variations are possible, both in form and function. For instance, any one or more of the following - the processor and/or memory and/or the input/output devices - could be resident on separate systems such as in a network environment. Any such variation to **Figure 1** is within the spirit and scope of the present invention.

The computer system and parts thereof depicted in the figures and described below, and the Java implementations described herein, are provided solely as examples for the purposes of explanation are not intended to necessarily imply architectural limitations. Those skilled in the art will recognize the numerous programming languages which may be utilized, all of which are believed to be embraced within the spirit and scope of the invention.

The system, method and program of a preferred embodiment of this invention enables the creation of a cross-platform installer program in accordance with the structural components and flow of **Figure 2**.

A script, referred to herein as "Installer.java", **101** in **Figure 2**, is used to run the install engine. The script implements the base installer class in Java. Within the script **101** there are the following entities: a) install properties **111**; b) an override function **112**; c) and a state machine **113**. Within the state machine **113**, there are various states **130** such as a welcome state, a destination state, a copy state, etc. This state machine includes an "add state method" **131** which is further used to check for errors. The following process takes place when the base installer class starts running: a) the properties are set up, **111**, b) the properties are

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overridden, **112**, and then c) the state machine **113** is executed. The program stays in the state machine **113** until exited out. At exit, the program has either been successfully or unsuccessfully installed.

5        Within any given state **130** there are several objects. There are helper classes **301**, GUI panels **302**, and a program object **303**.

10        Within the helper classes **301**, there is a modify file class **311**, a drive object class **312**, a J file class **313**, a J install class **314**, a run exec class **315**, and a text class **316**. The modify file class **311** and drive object **312** will be discussed in more detail either below or in a related application. J file **313** is a class that enables actions to be performed with files and  
15        directories. J install **314** contains methods that enables access to environment variables and enables other similar activities. Run exec **315** is a class that enables the running of operating system calls. Text class **316** is a class that is used to handle national language support.

20        An example of a GUI panel **320** is shown in **Figure 2**. There may be an image **321**, text or controls **322** and buttons **323** such as back, next or cancel. The GUI panels **320** all extend a class calling a wizard dialog. They are displayed in a mainframe class **329**. The mainframe  
25        class manages the screen display, e.g., gradient background color, text. It also manages the splash screens and titles and other similar items including where they are being displayed. In other words, it manages the background image and screen image upon which  
30        the dialogs are displayed.

      Within any given state there is also the heart of the install program, which is a program object **303** having fileset objects **340**. Within each fileset object **340** there are multiple install objects **330**. There are

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several types of install objects - file object **331**, registry object **332**, shortcut object **333**, directory object **334**, permissions object **335**, a library file object **336**, a dependency object **337**, and folder object **338**.

- 5 Other objects are also possible. All of these objects extend or implement install objects **330**. In addition, all of the install objects have certain methods on each of them. In particular, each install object knows how to install or uninstall itself, how to log itself, and how  
10 to internalize from a log, i.e., how to build itself back up again from reading from a log.

The install process that the script **101** enables includes running the state machine **113** through various states **130** which cause different events to take place.

- 15 For example, a GUI panel may pop up as part of the welcome state. During a destination state, another GUI panel may pop up on the screen that asks where the product is to be installed. The install properties **111** may be used in the destination state by having a  
20 destination panel set a particular destination directory name of an install property to a particular directory. During the copy state, the program object **303** is built up with all of the install objects **330** in them. The install command **304** is then called on the program object. Each  
25 one of the filesets **340** and install objects **330** contains an install method. As such, by calling install **304** on the parent object, i.e., the program object **303**, the program object goes through and calls install on all of the other objects **340**, **330** that it contains.

- 30 Likewise, the uninstall process is also enabled by the script **160**. For uninstall, there is an uninstall method on the fileset **340** and on all of the other install objects **330**. By calling uninstall **305** on the program

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**303**, everything becomes uninstalled, i.e., the program, filesets and install objects.

It should be noted that during an install, each one of the install objects **330** gets written out to a log file **140** which is put into a particular directory. At the same time that the install objects **330** log themselves to the log file, there is also another file, called "uninstall.Javal" **150** which implements a "base uninstall" class. It has several methods in it that get called at different points during uninstall. During install, the log **140** and "uninstall.Javal" **150** information are built. The log file **140** and "uninstall.Javal" **150** are in the file system **170** on a particular directory. If it is uninstalled, the first thing that happens is that it reads into "uninstall.Java2" **160** the log files **140** and recreates the same structure **160** as the filesets **340** and install objects **330**. It does not recreate the program object **303**, but rather it recreates the structure of everything contained within the program object, i.e., filesets **640** and install objects **630**. As a result, recreated from the log file **140** is a fileset with all of the install objects that it contains. There is one log file for each fileset. Directory **170** can be thought of as a container just like the program directory **303** is a container for the fileset **340** and install objects **330**.

"Uninstall.java2" **160** builds up the filesets **640**. Uninstall **605** is called by the uninstaller, and it goes through each fileset and install object and uninstalls itself. During the uninstall of each fileset **640**, the base uninstaller class **150** is called at the beginning and at the end of the fileset. Therefore, at the beginning and ending of copying a fileset **640**, the installer makes a call to the base uninstaller class **150** at appropriate points **601**, **602**, **603**, as discussed below. This allows



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certain things to happen when the fileset is being uninstalled.

There are certain platform specific operations that are taking place throughout the different objects, i.e., the helper classes **301**, install objects **330**, etc. Therefore, there is a platform specific module/interface, referred to herein as CPP **201**. CPP **201** defines a set of methods, that are representative of different operating systems, for functions that need to take place for an install. There are several different CPPs **211**, **212**, **213**, ...**219**, etc., one for each operating system. For example, CPP Win 32, CPP OS/2, CPP Solaris, CPP Linux, and CPP AIX. There is also a CPP default. If the operating system is not implemented through a CPP, the CPP default is used. This CPP **201** is the platform specific code for the installer.

Since most platforms, i.e., operating systems, do not have a registry, a platform independent registry database class **220** is created which ties the platform specific code **201** with registry objects **332**. The registry database **220** implements the registry function for those platforms which do not have a registry.

The above description presented an overview of the install program and how it works. The following describes, in more detail, various parts of the overall structure and process described above.

More specifically, the following describes an object oriented install architecture which includes the program object **303** and log file **140**. Within one or more of the states **130**, a program object **303**, various fileset objects **340**, and install objects **330** are defined and built up. First, a program object **303** is created. Then, fileset objects **340** are added to the program object **303**; and different install objects **330** are added to each fileset

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object **340**. Once the program object **303**, fileset objects **340** and install objects **330** are completely built up, the call "install" **304** on the program **303**, will call "install" on the fileset object **340** and all of the  
5 install objects **330**. Then, the fileset object **340** creates a log **140**. Each of the install objects **330** then logs to the particular log file **140** of the fileset object. When a fileset is done being installed, the log for that fileset is closed. The process continues with  
10 the next fileset. The next fileset creates a new logfile and the process repeats.

During uninstall **305**, the logfile **140** for each fileset **340** is used to recreate the fileset **640** and the install objects **630**. Uninstall **605** is then called on it,  
15 and it uninstalls all of the install objects that were installed. Then at different points within a fileset **640**, such as at begin and end, "uninstall" **605** calls two different methods **601**, **602** in the uninstall Java class **150** that is specific to this program.

20 Within the state machine **130**, a preferred embodiment of the invention has a state called "build fileset" **1301**. Within this "build fileset" state, one of the first steps creates a program object **1302**. The program object contains several parameters **1303** such as program name,  
25 program version, and where the directory is, that is, the directory where all of the log files will go into. Once the program object is created, filesets are added to it, **1304**. The code which adds filesets returns a fileset object, **1310**. A fileset object contains the log file  
30 name **1305**. The directory was specified by the program object, and the log file name itself is specified by the fileset object. In addition to the log file name, the fileset object contains the fileset name, fileset version, the location of the source files such as in a

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zip file or in a directory structure, **1306**. The filesset object also contains a variable true or false for identifying whether or not items are backed up when the install is taking place over the top of an existing  
5 program. In this way, if the latest version of the program is being uninstalled, the previous version that was previously installed underneath is now on top and available.

For each filesset, there is a method call  
10 "SetUninstall" **1308** which allows a user to selectively uninstall a filesset; i.e., a part of the program. For example, there may be several pieces or segments to the program such as documentation, base program files, a tutorial, etc. If the base is uninstalled, then  
15 everything gets uninstalled. However, if it is desired that only the tutorial be uninstalled, then the "SetUninstall method for the tutorial filesset can be set to true **1309**. This allows only the tutorial filesset to be uninstalled without uninstalling the entire program.

20 In other preferred embodiments, other items can be added to the filesset such as vendor information name, URL, etc. **1312**.

A user/programmer can new up any one of these install objects **1314**, and add it to the filesset to  
25 install it **1316**. For example, to install a program, the process would new up a file object and add it to the filesset which would represent a group of files to be installed.

As shown, a new program object was created, **1302**,  
30 and multiple filessets can be added to it just by repeating statement **1310**. Further statements, such as **1308**, **1312**, **1316**, do whatever a programmer wants to do to that filesset.

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There are many different install objects that can be added to a fileset of e.g., dependency objects, registry objects, etc. To add a dependency object, a new state called "CheckDep", i.e., check dependencies could be  
5 created **1318**. Within that state, a  
"fileset.checkDependencies" method **1319** would return a vector **1320** of all of the dependencies that are not yet installed. Dependencies are added to a fileset in the area of the program such as statements **1308**, **1312**. Then,  
10 with the one method call **1319** in the fileset, the program knows how to go through and check to see if everything that it requires to run is already installed. If everything it needs is not installed, then several tasks are undertaken as discussed separately below. If all of  
15 the dependencies are met, then the program enters a copy state.

It should be noted that in other embodiments, the states do not necessarily have to be unique, i.e., various functions can be combined into a single state, etc. However, for greater ease and flexibility, unique  
20 states having a fine granularity were defined in a preferred embodiment.

The copy state **1322** is described as follows. There is a method on a fileset called "addFiles()" **1324**. this  
25 is a shortcut way of newing up a file object, i.e., getting a file object, and adding it as in method "addObject(io)" **1316**. For example, a programmer may desire to add all of the programmer's html files **1326** that were in the source to some directory called  
30 C:myDir/html, **1328**. In doing this, the programmer has some options. The programmer may copy all sub directories **1330**; and when they are copied, the programmer may want to have a set of permissions **1332** and some owner or group of owners **1334**. This is the same

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type of information that is in the file object **1306**. However, there are some helper methods in the fileset class that enables a programmer to do this in one line rather than newing up a file object and then adding it.

5       More specifically, the addFiles() method **1324** instructs the install engine to look into the directory "myDir" which was specified in one of the parameters **1306** in adding a fileset object such as a parameter called data.zip. The install engine looks in the data.zip file,  
10       parses through it, and anything that matches the key **1326** or file name \*.HTML is copied into the specified directory **1328**, c:\myDir\html. As such a shortcut is set up. Other shortcuts can also be set up to perform other functions.

15       Checking disk space can also be performed **1340**. Because the program knows all of the filesets that it contains, the program asks each fileset how much space it needs and performs a check to verify that there is enough disk space. If it is determined that there is enough  
20       disk space, a program install is performed **1342**. "Prog.install" goes through all of the filesets that have been added to it **1310**, **1308**, **1312**, through the "add fileset()" method **1304**, and performs an install based on that. To complete this process, the install creates the  
25       logfiles in the directory.

For uninstall, reference is made to **Figure 4**. A directory **1400**, having a path name "c:\myprod\uninstall" may have several files shown as inst1.ju **1411**, inst2.ju **1412** and inst3.ju **1413** which represent three different  
30       filesets that make up the program "MyProd". The directory name "C:\myprod\uninstall" is passed to "uninstall". The uninstall process goes to the directory, and looks for all of the files that end in a designation representing a file to be uninstalled such as

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5 ".ju". Each such file is read in, and a new fileset **1440** is created for each one. As each file **1411-1413** is further read, there are install objects that are listed within each fileset. New install objects **1430** are then created. Once this is completed, what exists are filesets **1440** and install objects **1430** that are the same **340, 330 (Figure 2)** that were created during install. There is the same fileset, it is set up in the same way, with the same install objects, and they have the same methods on them. As such, there is a method on the fileset **1440** called "get dependency list" **1450** which checks to see if any of the programs that have been installed depend upon this fileset **1440**.

15 If there are programs that have been installed that depend upon a fileset **1440** that has been created during the uninstall process, then such a fileset should not be uninstalled. A message appears to the user during the uninstall process that warns against deleting the fileset because such a deletion could cause a program currently installed on the system to malfunction.

20 However, if no such dependencies exist for that fileset, then the uninstall method **1455** can be called on the fileset. The uninstall method goes through and calls uninstall on each install object within the fileset. Each install object removes itself. Then the fileset cleans itself up when it is removed by deleting its logfile **1411**. When the logfile is gone, the uninstall process repeats by going to the next fileset and doing the same uninstall process.

30 As part of the flow of uninstall in the uninstall class file, e.g., uninstall.Java **1460**, a new instance of an install object is created which is based upon what has been read in from the log of the log stream **1462**. A "CPP uninstall" method **1463** is performed. The type of the

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object, the object, and the uninstaller that is being  
used is passed to the "CPP uninstall" method. Most  
importantly, the object itself is being passed. This  
enables the platform specific module **201** (**Figure 1**) an  
5 opportunity to see what it is that is being uninstalled,  
and to override it or cancel it out. If the return "CPP  
Uninstall" **1463** is true, then that indicates that the  
platform specific module has handled the process of  
uninstalling the object and that the main uninstall  
10 process should not continue with uninstalling that  
particular install object.

As such, before the uninstaller calls the uninstall  
method **1455** for each install object **1430**, the uninstaller  
goes over to check with the platform specific code, CPP,  
15 **201** in **Figure 2**, and passes in the object that it is  
getting ready to uninstall. The CPP module has an  
opportunity to override the uninstall process by  
returning a result that indicates that the install object  
should not be uninstalled by the uninstall method.  
20 Statement **1463**, **Figure 4**, returns true if the CPP module  
handled the install object and the install object should  
not be handled by the uninstall method, i.e., the install  
object should not be uninstalled. If a not or false is  
returned, then the uninstall method will go ahead and  
25 uninstall the object since the platform specific module  
did not handle it. "O.uninstall" will call the uninstall  
method on these install objects. The install objects  
will then uninstall themselves.

Events similar to these also happen during the  
30 install process. For example, for each install object, a  
platform specific "install" method is called,  
"CPP.install" that passes the same or similar information  
as for the CPP uninstall method **1463** such as the type of  
object, the install object itself, and the installer.

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The platform specific install code looks at that install object, and has an opportunity to do something with the install object. Again, either a true or false is returned to indicate whether the platform specific code handled the install object and the install method 304 (Figure 2) should not install the install object or whether the platform specific code did not handle it, or do anything with it, and therefore the install method 304 can go ahead and install it.

10       The above described technique is useful and needed when one tries to simulate an install on a platform specific operating system's install mechanism. For example, for the AIX operating system, all of the programs that are to be installed have to be first  
15 collected so that they can be added to a database. The database has to be updated with all the programs or all the files that were copied onto the system so that they can be considered to be installed correctly. This feature is useful for install and uninstall.

20       As mentioned above, the present invention provides an installer application and toolkit apparatus and method for installing programs in a manner that all variables and variable values used during the installation process are stored for later use by other applications or by an  
25 uninstall application. In this way, other applications may gather information about the installation of programs already present on a computing system and uninstall applications may obtain information about the installation variable values used to install a particular  
30 program being uninstalled.

Typically, installation programs store only the filenames, paths and version numbers of programs being installed. This information is then used by the uninstall application to remove the files having the



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designated filenames and version numbers located at the identified path. Known installation programs do not store any of the variables or variable values, such as user identifiers, and other user defined or installation  
5 program generated variables that are used during the installation process but do not directly represent items that need to be uninstalled. As a result, much of the information regarding the settings and manner by programs are installed is lost after installation.

10 With the present invention, however, all variables and variable values are stored for later use by uninstall programs and/or other applications. In this way, the variables and variable values may be used to determine the exact settings established during installation of a  
15 program so that other applications may install properly and the uninstall program may uninstall the application appropriately.

Moreover, by storing all installation variables and variable values during installation, developers need not  
20 be limited by the amount of information selected for storage by an installation program developer. For example, if an installation program developer decided that only the filename and path were to be stored in a fileset by the installation program, a developer of an  
25 uninstall program is limited to offering the features associated with the filename and path in the uninstall program.

By storing all of the installation variables and variable values, the developer of an uninstall program is  
30 free to customize the uninstall program in any manner he/she deems fit. Since all of the variables and variable values are available, the developer of the uninstall program need not be concerned about what information is available to the uninstall program. Thus,

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development of uninstall programs is made less work intensive. In addition, by storing all installation variables and variable values in a system product registry, other installation programs may retrieve  
5 information about already installed programs in order to further customize the installation of later programs.

**Figure 5** is an exemplary block diagram illustrating one exemplary embodiment of the present invention. As shown in **Figure 5**, the present invention includes an  
10 installation program **510** that is used to install an application on a computing system **520**. During install, variables and variable values, hereafter referred to as installation properties, are identified and stored in  
15 hashtables **530** of filesets **540** for the application being installed. Installation properties are any variables and variable values input by the user during installation or generated by the installation program during installation of the application. Thus, any user selections from  
20 menus, typed-in information supplied by the user, variables and variable values automatically generated by the installation program, and the like, are included as installation properties that may be stored in hashtables  
**530** of filesets **540** for later use by uninstall programs.

Once the installation is completed, the filesets **540**  
25 are serialized, and thus the hashtables **530** in the filesets **540** are serialized, and stored to a storage media **550**. In this way, the installation properties are stored in the serialized fileset for use by an uninstall program. Thus, the uninstall program will have access to  
30 all of the installation properties when the fileset is reinstantiated from the serialized fileset.

When the uninstall program is run on the installed application, the uninstall program reinstantiates the filesets from the serialized filesets stored on the

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storage media **550**. In reinstantiating the filesets, what is meant is that the uninstall program generates filesets and initializes the parameters of the filesets to those identified in the serialized filesets read from the

5 storage media **550**. In addition, the uninstall program may read the installation properties from the serialized filesets and store these installation properties to the system registry **560** for the application. In this way, information regarding the particular selections and  
10 entries made by the user during installation, and the variables and variable values generated by the installation program during install is made available to other programs. This information may be used to further customize the uninstall program.

15 For example, consider an installation program that needs to stop a service running on Microsoft Windows 2000™, install some files, and then restart the service. The installation program must look at the system and determine how to stop and start the service. If this  
20 knowledge is saved, then the uninstall program does not need to rediscover how to stop and start the service in order to uninstall the application. Rather, with the present invention, the uninstall program may retrieve the commands needed from the installation variables to stop  
25 the service, uninstall the required files, and then restart the service again.

**Figure 6** is an exemplary block diagram illustrating an alternative embodiment of the present invention. As shown in **Figure 6**, in this embodiment of the present  
30 invention an installation program **610** is provided that is used to install an application on a computing system **620**. During install, a fileset **630** is created to hold the

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install properties for the application being installed so that these properties may be used by other programs. The install properties are enumerated and registry objects **640** are created in the system product registry **650** for  
5 the application install properties.

Once all of the install properties are added to the system product registry **650** as registry objects **640**, the fileset **630** is installed. In this way, the install properties for the application are added to the system  
10 product registry **650** which is accessible by other programs of the computing system **620**. In this way, when other programs are being installed on the computing system **620**, the installation programs may query the system product registry **650** for the install properties in  
15 order to better customize the installation of these other programs.

In both embodiments shown in **Figures 5 and 6**, it is sometimes necessary to "filter out" some of the install properties so that they are not stored or made accessible  
20 by other programs. For example, properties that may constitute a security risk if made available to other programs may be masked from being stored in the fileset hashtable of system product registry. Such filtering or masking may be based, for example, text strings appearing  
25 in the variable names and the like. Other methods of filtering may include having a list of properties to mask, having a property object that has a "mask" method that can be set to deselect the property object from being stored, and the like. Any mechanism for filtering  
30 or masking may be used without departing from the spirit and scope of the present invention.

In addition, while **Figures 5** and **6** are depicted as separate embodiments of the present invention, it should be appreciated that the embodiments shown in **Figures 5** and **6** may be combined or individual aspects of each of these embodiments may be combined in order to achieve the purposes of the present invention. Moreover, other embodiments in which additional features are added to one or more of the embodiments shown in **Figures 5** and **6** may be used without departing from the spirit and scope of the present invention.

**Figure 7** is a flowchart outlining an exemplary operation of the present invention when storing variables and variable values, i.e. installation properties, to a fileset. As shown in **Figure 7**, the operation starts with enumerating filesets in the program object (step **710**). Then, a determination is made as to whether there is an additional fileset (step **720**). If not, the operation ends. Otherwise, the operation continues to step **730**.

If there is an additional fileset, the fileset is initialized (step **730**). The install properties of the fileset are enumerated (step **740**). A determination is made as to whether there is an additional install property for the fileset (step **750**). If so, a determination is made as to whether the property name contains a restricted string, e.g. "password" (step **760**). If so, the operation returns to step **750** without storing the additional install property. Otherwise, if the property name does not include a restricted string, the additional install property is stored into the fileset (step **770**). As previously discussed above, the storing into a fileset may include, for example, storing the

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install property in a hashtable of the fileset that is part of the serialization of the fileset. The operation then returns to step **750**.

If there are no more additional install properties  
 5 in step **750**, the operation installs the fileset (step **780**). A determination is then made as to whether the installation of the fileset was successful (step **790**). If successful, the operation returns to step **720**. If the installation of the fileset was not successful, the  
 10 fileset is uninstalled and clean up procedures are performed (step **795**). The operation then ends.

The following is exemplary code for implementing the flowchart shown in **Figure 7**. The following code is for illustration only and is not intended to imply any  
 15 limitation on the manner by which the present invention may be implemented.

```

/**
 * Install the program. This method calls the install of
 20 * each fileset in the program.
 *
 * @return result of operation OK, CANCEL, or message
 */
public String install(){
 25     String r = "OK"; //result of operation
    ...
    //install all filesets if no errors occurred
    if (r.equals("OK")){

 30         //Make call to CPP for further processing if necessary

        cpp.install("INIT", this, null);

        for (int i=0; i<fileset.size(); i++){
 35             Fileset fs = (Fileset)fileset.elementAt(i);

```

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```

//Set uninstall key used for entire program so we
//know what registry keys to delete when
uninstalling

5      fs.uninstallName = uninstallName;
      fs.uninstallDesc = uninstallDesc;
      fs.uninstallCommand = uninstallCommand;
      fs.uninstallDir = uninstallDir;

10     //Save install properties to every fileset
      for (Enumeration e = installp.keys(); e
hasMoreElements();) {

        String key = (String)e.nextElement();
        String value = (String)installp.get(key);

15         //Do not save any passwords
        String lcKey = key.toLowerCase();
        If (lcKey.indexOf("password")==-1) {
            fs.temp.put(key, value);

20         }

        //Install the fileset
        r = fs.install();

25         //If there was an error, then stop calling filesets and
        //call uninstall on previous filesets, the return error.
        If (!(r.equals("OK"))){
            uninstall(true);
            i = fileset.size();

30         }
    }
    return r;
}

```

35       **Figure 8** is a flowchart outlining an exemplary operation of the present invention when storing variables and variable values, i.e. installation properties to a fileset. As shown in **Figure 8**, the operation starts by

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creating a fileset to hold the installation properties  
(step **810**). The install properties are then enumerated  
(step **820**) and a determination is made as to whether  
there is an additional installation property to be stored  
5 in the fileset (step **830**). If so, a determination is  
made as to whether the property name includes a  
restricted string (step **840**). If so, the operation  
returns to step **830** without storing the property in the  
system registry. If the property name does not include a  
10 restricted string, a registry object is added with the  
property name and value (step **850**). The operation then  
returns to step **830**.

If there are no more additional properties in step  
**830**, the fileset is installed (step **860**). A  
15 determination is then made as to whether the fileset was  
installed properly (step **870**). If so, the operation  
ends. Otherwise, if the installation was not properly  
completed, the fileset is uninstalled and clean up  
operations are performed (step **880**), after which the  
20 operation ends.

The following is exemplary code for implementing the  
flowchart shown in **Figure 8**. The following code is for  
illustration only and is not intended to imply any  
limitation on the manner by which the present invention  
25 may be implemented.

```

/**
 * Install the program. This method calls the install of
 * each fileset in the program.
30  *
 * @return result of operation OK, CANCEL, or message
 */
public String install(){

```



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```

String r = "OK"; //result of operation
...

//Create fileset for adding variables for use by other programs
5
Fileset rinfo = addFileset(
    "ITJInfo",
    "ITJ Info",
    "1.0",
10    "ITJ Info",
    "," + File.separator,
    backup);

//Add uninstall information to system product registry
15 RegistryObject displayName = new RegistryObject();
    displayName.setKeyRoot(Jinstall.HKEY_LOCAL_MACHINE);

    DisplayName.setKeyName("Software\\Microsoft\\Windows\\CurrentVersion\\Uninstall\\" + uninstallName + "\\DisplayName");
20    displayName.setKeyValue(uninstallDesc);
    rinfo.addObject(displayName);

    RegistryObject uninstallString = new RegistryObject();
    uninstallString.setKeyRoot(Jinstall.HKEY_LOCAL_MACHINE);
25    uninstallString.setKeyName("Software\\Microsoft\\Windows\\CurrentVersion\\Uninstall\\" + uninstallName + "\\UninstallString");
    uninstallString.setKeyValue(uninstallCommand);
    rinfo.addObject(uninstallString);
30

    RegistryObject logDirString = new RegistryObject();
    logDirString.setKeyRoot(Jinstall.HKEY_LOCAL_MACHINE);

    logDirString.setKeyName("Software\\Microsoft\\Windows\\CurrentVersion\\Uninstall\\" + uninstallName + "\\LogDir");
35    logDirString.setKeyValue(logDir);
    rinfo.addObject(logDirString);

    RegistryObject itjString = new RegistryObject();

```

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```

        itjString.setKeyRoot(Jinstall.HKEY_LOCAL_MACHINE);

        itjString.setKeyName("Software\\Microsoft\\Windows\\CurrentVerison\\Unins
tall\\" + uninstallName + "\\ITJ");
5         itjString.setKeyValue ("T");
        rinfo.addObject(itjString);

        //Add all install variables to system product registry
        InstallProperties installp = install.getProperties();
10        for (Enumeration e = installp.keys(); e.hasMoreElements();){
            String key = (String)e.nextElement();
            String value = (String)installp.get(key);

            //Do not save any passwords
15            String lcKey = key.toLowerCase();
            if (lcKey.indexOf("password")==-1){
                registryObject props = new RegistryObject();
                props.setKeyRoot(Jinstall.HKEY_LOCAL_MACHINE);
                props.setKeyName("Software\\IBM\\ITJ\\" +
20                uninstallName + "\\\" + logDir + "\\\" + key);
                props.setKeyValue(value);
                rinfo.addObject(props);
            }
        }
25        //Install all filesets if no errors occurred
        if (r.equals("OK")){
            ...
        }
        return r;
30    }

```

As described above, the present invention provides a mechanism through which all of the all of the installation properties may be stored for later use by an  
 35 uninstall program or other applications. In this way, the uninstall program may obtain all of the necessary information to recreate the state of the filesets at installation of the program and other applications may

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obtain information regarding the settings and variable values used during installation of another program in order to better customize their own installation.

Thus, the present invention provides a mechanism  
5 that allows developers of installation programs and  
uninstall programs to have flexibility in customizing  
these programs, due to the availability of all  
installation properties. That is, developers of  
installation programs and uninstall programs are not  
10 restricted by the particular properties deemed  
significant by the developer of the original installation  
program for an installed application.

It is important to note that while the present  
invention has been described in the context of a fully  
15 functioning data processing system, those of ordinary  
skill in the art will appreciate that the processes of  
the present invention are capable of being distributed in  
the form of a computer readable medium of instructions  
and a variety of forms and that the present invention  
20 applies equally regardless of the particular type of  
signal bearing media actually used to carry out the  
distribution. Examples of computer readable media  
include recordable-type media, such as a floppy disk, a  
hard disk drive, a RAM, CD-ROMs, DVD-ROMs, and  
25 transmission-type media, such as digital and analog  
communications links, wired or wireless communications  
links using transmission forms, such as, for example,  
radio frequency and light wave transmissions. The  
computer readable media may take the form of coded  
30 formats that are decoded for actual use in a particular  
data processing system.

The description of the present invention has been  
presented for purposes of illustration and description,

and is not intended to be exhaustive or limited to the invention in the form disclosed. Many modifications and variations will be apparent to those of ordinary skill in the art. The embodiment was chosen and described in order to best explain the principles of the invention, the practical application, and to enable others of ordinary skill in the art to understand the invention for various embodiments with various modifications as are suited to the particular use contemplated.

and is not intended to be exhaustive or limited to the invention in the form disclosed. Many modifications and variations will be apparent to those of ordinary skill in the art. The embodiment was chosen and described in order to best explain the principles of the invention, the practical application, and to enable others of ordinary skill in the art to understand the invention for various embodiments with various modifications as are suited to the particular use contemplated.